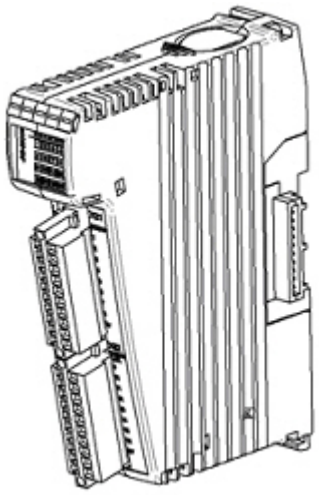
JX3-THI2-TC

Peripheral Module



JetWeb

User Manual

Jetter
Automation. Made easy.

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Revision 1.01.2

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This User Manual is an Integral Part of the JX3-THI2-TC Module:

Type: _____

Serial #: _____

Year of construction: _____

Order #: _____

CE

To be entered by the customer:

Inventory #: _____

Place of operation: _____

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Significance of this User Manual

This manual is an integral part of the JX3-THI2-TC module, and

- must be kept in a way that it is always at hand until the JX3-THI2-TC module will be disposed of.
- If the JX3-THI2-TC is sold, alienated or loaned, this manual must be handed over.

In any case you encounter difficulties to clearly understand this user manual, please contact the manufacturer.

We would appreciate any suggestions and contributions on your part and would ask you to contact us. This will help us to produce manuals that are more user-friendly and to address your wishes and requirements.

This manual contains important information on how to transport, erect, install, operate, maintain and repair the JX3-THI2-TC module.

Therefore, the persons carrying out these jobs must carefully read, understand and observe this manual, and especially the safety instructions.

Missing or inadequate knowledge of the manual results in the loss of any claim of liability on part of Jetter AG. Therefore, the operating company is recommended to have the instruction of the persons concerned confirmed in writing.

History

Revision	Comment
1.01.1	Original issue
1.01.2	Changes, see ***Recent Revisions*** (on page 67)

Description of Symbols

Warning

This sign is to indicate a possible impending danger of serious physical damage or death.

Caution

This sign is to indicate a possible impending danger of light physical damage. This sign is also to warn you of material damage.

Warning

This sign indicates hazard of life due to electric shock caused by a high operating voltage.

Warning

This sign is to indicate hazard of serious physical damage or death due to accidentally touching dangerous parts of the device.

Warning

You have to wear goggles. Failure to comply may lead to bodily injuries.

Warning

This sign is to warn you of material damage due to applying hard blows or shocks to the motor flange and shaft.

Important

This sign is to indicate a possible impending situation which might bring damage to the product or to its surroundings.

It also identifies requirements necessary to ensure faultless operation.

You will be informed of various possible applications and will receive further useful suggestions.

It also gives you words of advice on how to efficiently use hardware and software in order to avoid unnecessary efforts.

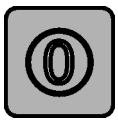
Note

· / -

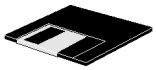
Enumerations are marked by full stops, strokes or scores.

Operating instructions are marked by this arrow.

Automatically running processes or results to be achieved are marked by this arrow.



Pictorial representation of PC and HMI keys.



Reference to a program or file.

This symbol informs you of additional references (data sheets, literature, etc.) associated with the given subject, product, etc. It also helps you to find your way around this manual.

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1 Safety Instructions

1.1 Generally Valid Safety Instructions

This device complies with the valid safety regulations and standards. Special emphasis was given to the safety of the users.

Of course, the user should adhere to the following regulations:

- relevant accident prevention regulations;
- accepted safety rules;
- EC guidelines and other country-specific regulations.

1.1.1 Intended Conditions of Use of the JX3-THI2-TC

The intended conditions of use include operation in accordance with the user manual.

The JX3-THI2-TC module is a JX3 expansion module equipped with two analog inputs for connecting analog temperature sensors. It can be connected to the JX3 system bus. The JX3 system bus starts at the JX3-BN-xxx module. Via JX3-BN-CAN module, the JX3-THI2-TC module can be connected to all controllers of the JetControl series. The JX3-BN-XXX or JX3-PS1 module supplies the JX3-THI2-TC module with voltage. This operating voltage is classified as SELV (Safety Extra Low Voltage). The JX3-THI2-TC module is therefore not subject to the EU Low Voltage Directive.

The JX3-THI2-TC module may only be operated within the limits of the stated specifications.

The device is used to control machinery, such as conveyors, production machines, and handling machines.

1.1.2 Usage other than intended

This device must not be used in technical systems which to a high degree have to be fail-safe, e.g. ropeways and aeroplanes.

If the device is to be run under ambient conditions which differ from the conditions mentioned in chapter ***Operating Conditions*** (page 75), the manufacturer is to be contacted beforehand.

1.1.3 Who may operate the device?

Only instructed, trained and authorized persons are permitted to operate this device.

Transport:	Only by personnel with knowledge in handling electrostatically sensitive components.
Installation:	Only by specialists with training in electrical engineering.
Commissioning:	Only by specialists with profound knowledge of, and experience with, electrical engineering / drive technology.

1.1.4 Modifications and Alterations to the Module

For safety reasons, no modifications and changes to the device and its functions are permitted.

Any modifications to the device not expressly authorized by the manufacturer will result in a loss of any liability claims to Jetter AG.

The original parts are specifically designed for the device. Parts and equipment from other manufacturers are not tested on our part, and are, therefore, not released by us.

The installation of such parts may impair the safety and the proper functioning of the device.

Any liability on the part of Jetter AG for any damages resulting from the use of non original parts and equipment is excluded.

1.1.5 Repair and Maintenance

This device must not be repaired by the operators themselves. The device does not contain any parts that could be repaired by the operator.

The device must be sent to Jetter AG for repair.

1.1.6 Decommissioning and Disposing of

The environmental regulations of the respective country must be complied with when decommissioning and disposing of devices on the operating company's premises.

1.2 Ensure Your Own Safety

Warning

- Disconnect the JX3-THI2-TC module from the mains to carry out maintenance work. By doing so, you will prevent accidents resulting from electric voltage and moving parts.
- Safety and protective devices, e.g. the barrier and cover of the terminal box must never be shunted or by-passed.
- Dismantled protective equipment, such as guards, must be reattached prior to commissioning and checked for proper functioning.
- Prior to commissioning, the machine manufacturer shall conduct a hazard analysis for the machine and take appropriate measures to prevent personal injury and damage to property resulting from accidental movements.

1.2.1 Malfunctions

- **In case of failures or damages, disconnect the device from the mains immediately.**
- Malfunctions or other damages are to be reported to a responsible person at once.
- The device must be protected from improper or inadvertent use.

1.2.2 Information Signs and Labels

- Markings, information signs, and labels always have to be observed and kept readable.
- Damaged or unreadable information signs and labels have to be replaced.

1.3 Instructions on EMI

The noise immunity of a system depends on the weakest component of the system. For this reason, correct wiring and shielding of cables is of paramount importance.

Important!

Measures for increasing EMI in electric plants:

- The JX3-THI2-TC module has to be attached to a DIN rail acc. to EN 50022-35 x 7.5.
- If correct measurements are required, the sensor cables connected to inputs X41 and X42 of the JX3-THI2-TC module have to be looped through a ferrite core at least once or twice. This way, external interferences can be minimized. This reduction of interferences can be achieved by using a round cable snap ferrite (e.g. by Würth Elektronik, part # 74271222). Tests with an RF injection (10 V/m) resulted in a higher susceptibility to interference. The measuring accuracy decreased from 0.5°C to 1.5°C in the range of up to 450°C.
- Follow the instructions given in Application Note 016 "EMC-Compatible Installation of the Electric Cabinet" published by Jetter AG.

The following instructions are excerpts from Application Note 016:

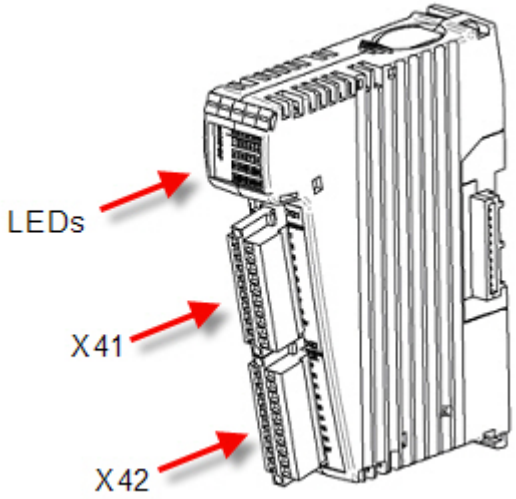
- On principle, **physical separation** should be maintained between signal and voltage lines. We recommend spacings greater than 20 cm. Cables and lines should cross each other at an angle of 90°.
- Shielded cables are to be **used** for the following lines:

  Analog lines, data lines, motor cables coming from inverter drives (servo output stage, frequency converter), lines between components and interference suppressor filter, if the suppressor filter has not been placed at the component directly.
- Shield cables **at both ends**.
- Unshielded wire ends of shielded cables should be as short as possible.
- The **entire** shield must be drawn behind the isolation, and then be clamped under an earthed strain relief with the **greatest possible surface area**.

2 Introduction

2.1 Description of the JX3-THI2-TC Module

The JX3-THI2-TC module is a JX3 expansion module for connecting thermocouples. This module is equipped with 2 inputs. Via JX3-BN-CAN module, the JX3-THI2-TC module can be connected to all controllers of the JetControl series.

Description of the JX3-THI2-TC Module	
	
Article #	10000611
Module Code	312
LED Display	Supply Voltage Communication Hardware error
Terminal X41	1 input for connecting thermocouples
Terminal X42	1 input for connecting thermocouples
Additional functions	• Averaging • Monitoring and evaluation of limits • Operating system update by means of JetSym • Slave pointer • Oscilloscope function • Potentiometer mode • Forcing

2.2 JX3-THI2-TC - Minimum Requirements

The functions described in this document make the following minimum requirements to modules, controllers and software.

Minimum Requirements	
Module / Controller / Software	**Starting from software release**
JX3-THI2-TC	V 1.01.0.01
JX3-BN-CAN	V 1.04
JC-24x	V 3.23 Oscilloscope Function: V 3.24
JX6-SB / JX6-SB-I	V 2.18 Oscilloscope Function: V 2.19
JC-64x	V 3.50
JetSym	V 3.00 Oscilloscope Function: V 4.00
JM-D203-JC-24x	V 1.12 Oscilloscope Function: V 1.13

2.3 JX3-THI2-TC - Scope of Delivery

JX3-THI2-TC - Scope of Delivery		
Article #	**Quantity**	**Description**
10000611	1	JX3-THI2-TC
60869252	2	BU_10_BLZF_SW_RM3.5 10-pin male connector, spring cage technology, contact spacing 3.5 mm
60870411	10	DIV_DEK_5/5_MC-10_NEUT._WS Terminal labels
60871941	1	Installation instruction
60870410	1	DIV_BL_SL_3.5_KO_OR Keying pins

2.4 List of Documentation

Document Survey of the JX3-I/O System

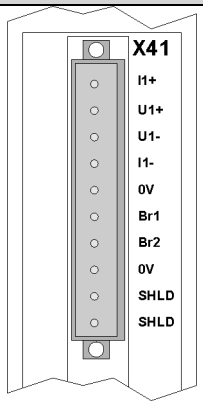
JX3-I/O System - User Information
JX3-THI2-TC - Installation Instructions

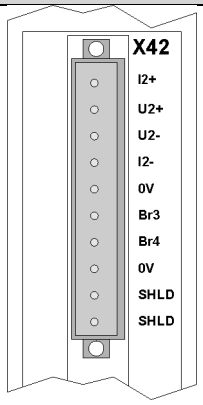
3 Description of Connections

3.1 JX3-THI2-TC - Functional Data of Temperature Inputs

Functional Data	
Input quantity:	Two independent channels for thermocouples
Conversion time for measured temperature	approx. 90 to 150 ms in "slow mode" approx. 8 to 15 ms in "fast mode" The conversion time depends on the measured temperature.
Resolution	0,01°C
Accuracy	See chapter “Accuracy/Noise”. Cold-junction typically < 4 °C. 10-fold averaging, ambient temperature 25°C, accuracy to DIN IEC 60584, class A
Filtering	Software filtering, 2- to 64-fold averaging, moving average

3.2 JX3-THI2-TC - Assignment of Terminals X41 and X42

Assignment of Terminal X41			
View	Analog input # 1		
	**Pin**	**Signal**	**Comment**
	X41.I1+	I1+	Jumper to 0V
	X41.U1+	U1+	Terminal for the positive side of thermocouple 1
	X41.U1-	U1-	Jumper to 0V
	X41.I1-	I1-	Terminal for the negative side of thermocouple 1
	X41.0V	0V	Ground
	X41.BR1	NC	not connected
	X41.BR2	NC	not connected
	X41.0V	0V	Ground
	X41.SHLD	SHLD	Shielding terminal
	X41.SHLD	SHLD	Shielding terminal

Assignment of Terminal X42			
View	Analog input # 3		
	**Pin**	**Signal**	**Comment**
	X42.I2+	I2+	Jumper to 0V
	X42.U2+	U2+	Terminal for the positive side of thermocouple 2
	X42.U2-	U2-	Jumper to 0V
	X42.I2-	I2-	Terminal for the negative side of thermocouple 2
	X42.0V	0V	Ground
	X42.BR3	NC	not connected
	X42.BR4	NC	not connected
	X42.0V	0V	Ground
	X42.SHLD	SHLD	Shielding terminal
	X42.SHLD	SHLD	Shielding terminal

This configuration applies to Rev00. Rev01 will no longer require additional jumpers.

Please use only the provided connectors by Weidmüller (order # 60869252), or identical connectors.

If BL-IO-3.5 LED is used, incorrect measurements will result as the electronic parts integrated into the connector influence the measurements.

3.3 Connecting Thermocouples

Between I1+ and U1-, as well as between U1- and 0V for the first channel, or I2+ and U2-, as well as between U2- and 0V for the second channel two jumpers have to be plugged in.

These jumpers must designed in a way to ensure that the resistance between the terminals is significantly less than 0.1 Ω.

This configuration applies to Rev00.

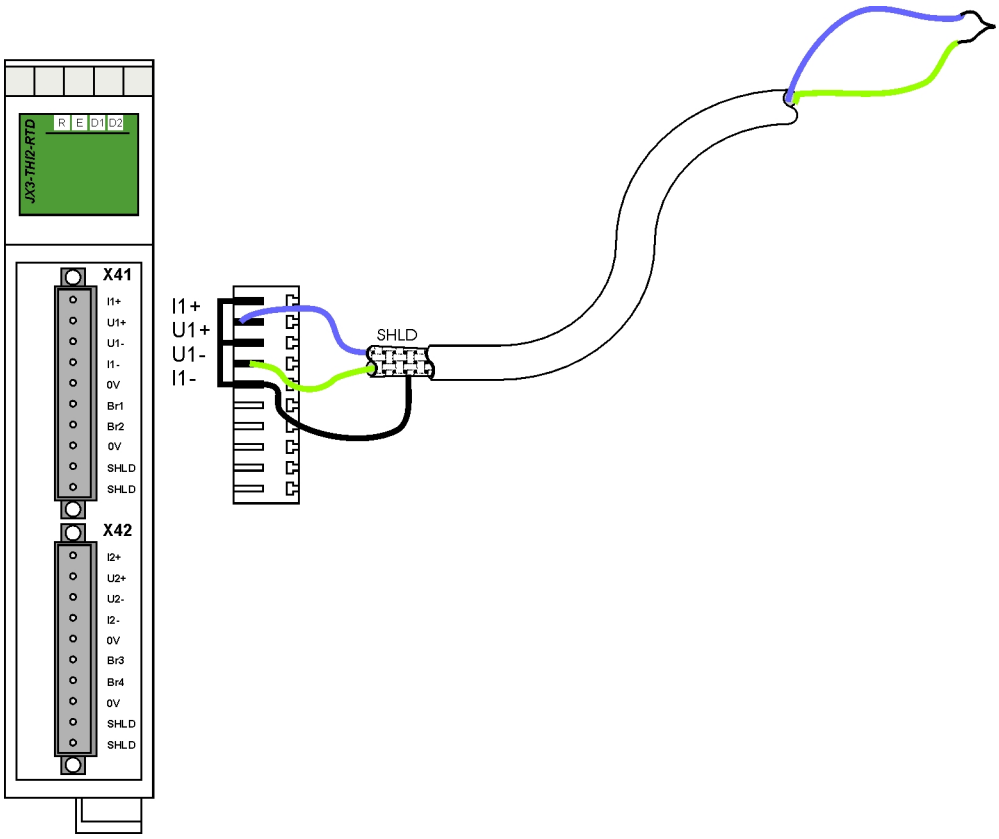


Figure 1: Connecting a Thermocouple

3.4 Improving the Noise Immunity

For improving the noise immunity, please give heed to the following rules:

- For the connection of analog sensors, use a shielded connector.
- Connect the shielding to terminal X41, respectively X42 directly.
- Use a shielding terminal (1) for additionally earthing the shield of the wire.
- Use a round cable snap ferrite (e.g. 74271222 by Würth Elektronik).

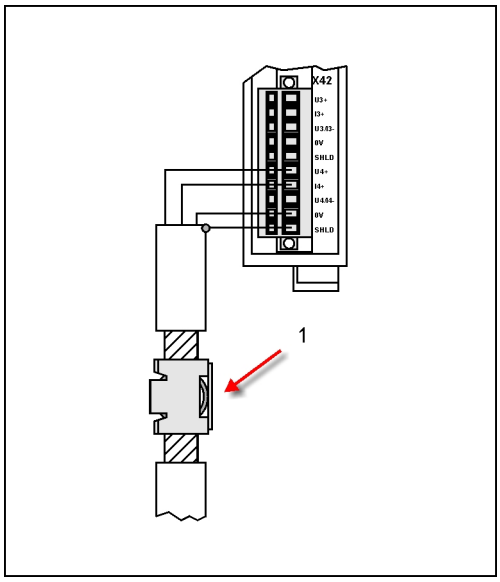


Figure 2: Additional earthing of a shield by means of a shielding terminal

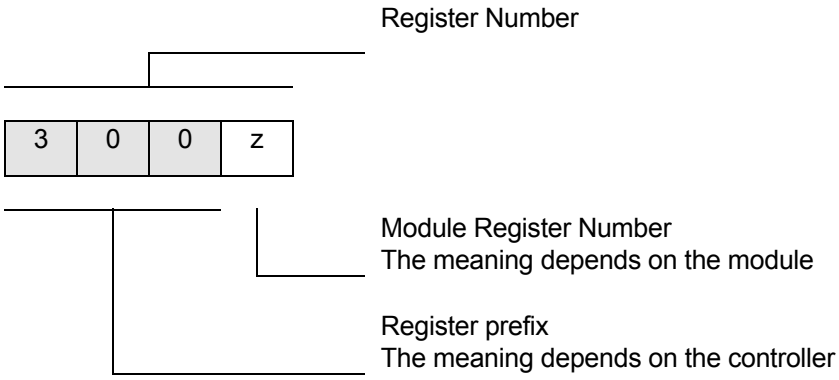
4 Numbering of Registers and I/Os

4.1 Register Addressing

4.1.1 Register Array for JX3 Modules

Each JX3 module is equipped with over 10,000 module registers. The module registers, on the other hand, have been assigned to the controller registers. By means of registers, process, configuration and diagnose data can be read by module JX3-THI2-TC, respectively written to the module.

Registers can be accessed directly in the application program of the controller, in a setup pane of JetSym, or via the user interface directly.

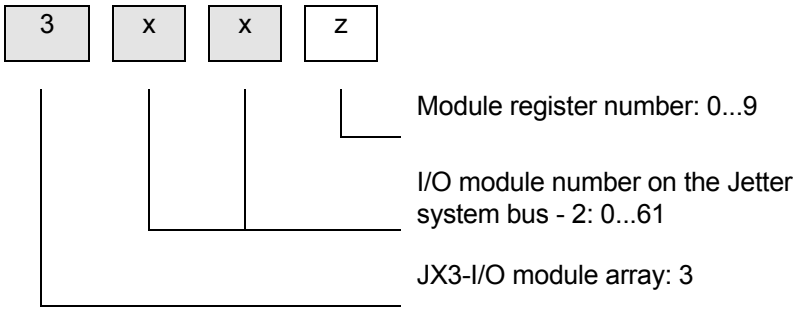


The register number results from a register prefix and a module register number. The register prefix depends on the position of the JX3-THI2-TC module in the Jetter system bus, and on the controller that is applied.

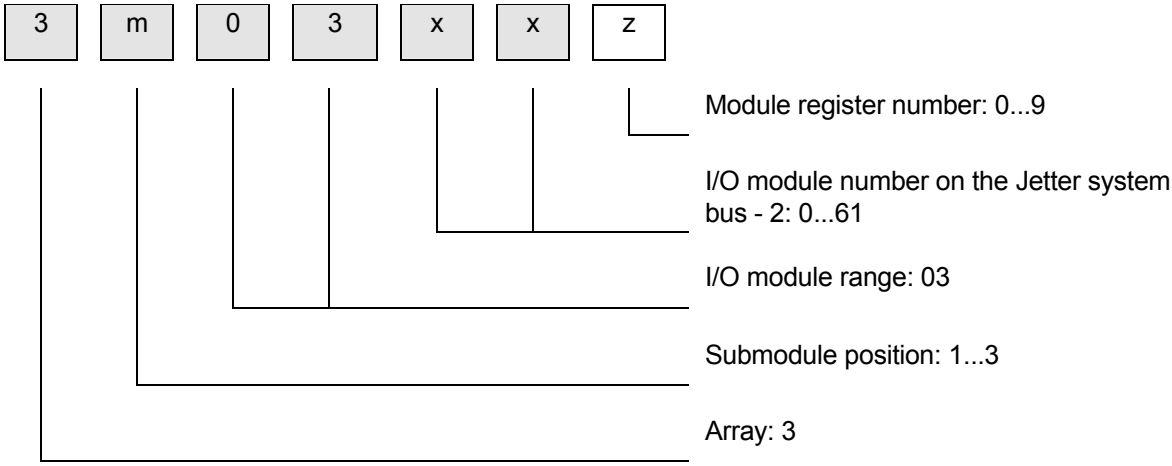
At determining the register prefixes, the following parameters have to be considered:

- Controller (JC-24x, JC-64x, JC-800, JM-D203-JC-24x)
- Submodule position (at JX6-SB, JX6-SB-I)
- I/O module number in the Jetter system bus

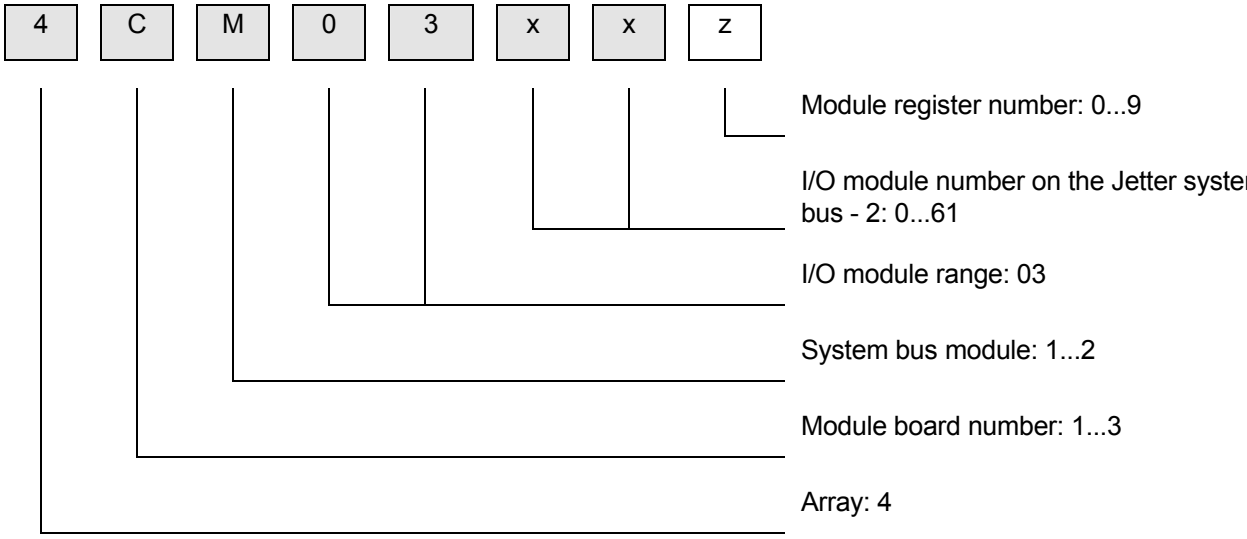
JX3-I/O-modules connected to JC-24x and JM-D203-JC-24x



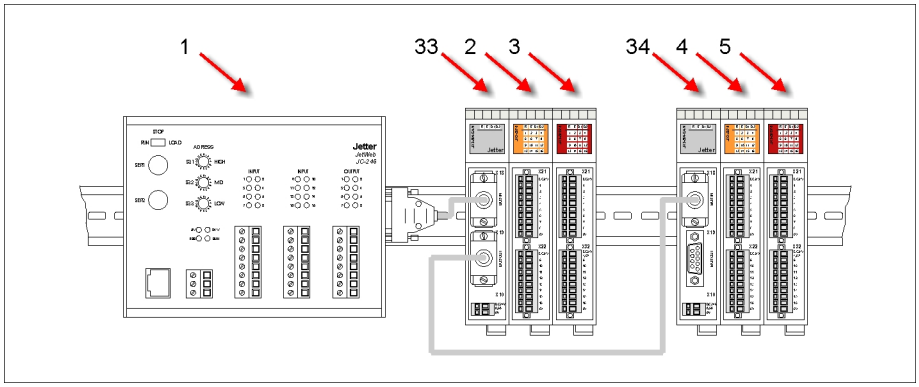
JX3-I/O modules with JX6-SB(-I) and JC-647 modules



JX3-I/O modules with JX6-SB(-I) and JC-800 modules



Example: Register and I/O Addressing of a JX3 Module on the Jetter System Bus



Six modules, JX3-BN-CAN (33, 34), JX3-DI16 (2, 4) and JX3-DIO16 (3, 5), have been connected to a JC-24x (1) controller. The register and I/O numbers listed in the table below result from the module position on the Jetter system bus.

- On the Jetter system bus, no I/O numbers have been assigned to the JX3-BN-CAN.
- The first JX3-BN-CAN connected to the JetControl is assigned the I/O module number 33.
- The first JX3 module is assigned I/O module number 2.

Register and I/O Numbers			
IO Module Number	**Module**	**Register Number**	**IO Numbers**
1	JC-24X	0 ... 1999 20000 ... 49999	101 ... 116
33	JX3-BN-CAN	3310 ... 3319	-
02	JX3-DI16	3000 ... 3009	201 ... 216
03	JX3-DIO16	3010 ... 3019	301 ... 316
34	JX3-BN-CAN	3320 ... 3329	
04	JX3-DI16	3020 ... 3029	401 ... 416
05	JX3-DIO16	3030 ... 3039	501 ... 516

4.1.2 Direct Access to JX3 Module Registers

Each JX3 module is equipped with over 10,000 module registers. Eight of these are directly accessible via Jetter system bus.

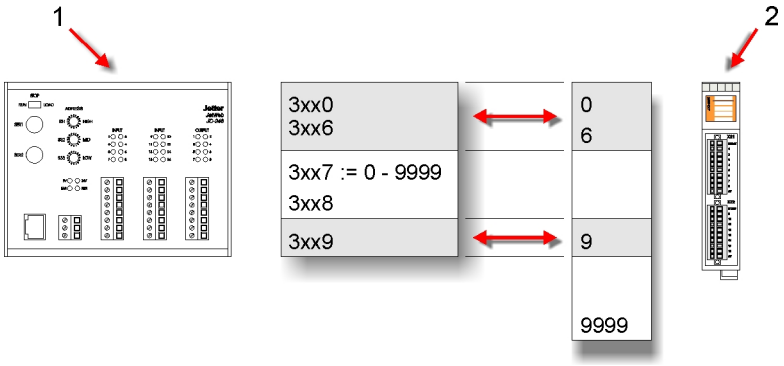


Figure 3: Direct register access to JX3 modules

Above, direct access to the JX3 module registers (2) has been illustrated. On the Jetter system bus of a JC-24x controller, the JX3 modules can be accessed via register numbers 3xxz (1). Access to JX3 module registers 0 through 6, as well as 9 is carried out directly via register 3xxz.

Register Numbering Dependent on the Controller

- For JC-24x controllers: Register number 3xxz
- For JC-647 controllers: Register number 3m03xxz
- For JC-800 controllers: Register number 4CM03xxz

Example: Directly Checking the Communication with the JX3 Modules

In a JX3-BN-CAN module, communication with the connected JX3 modules is to be checked. For this, bit 15 in register 0 the **status of the JX3-BN-CAN** must be queried.

```
VAR
      nm_State : INT at %vl 3310;            //   Status register JX3-BN-CAN
END_VAR;

CONST
      c_ComActive = 15;                      //   Bit number
END_CONST;

TASK 0
      WHEN
      BIT_SET (nm_State, c_ComActive)        //   Communication active
      CONTINUE;
                                             //   ...
END_TASK;
```

4.1.3 Indirect Access to JX3 Module Registers

Each JX3 module is equipped with over 10,000 module registers. One index and one data register make access to all 10,000 module registers possible.

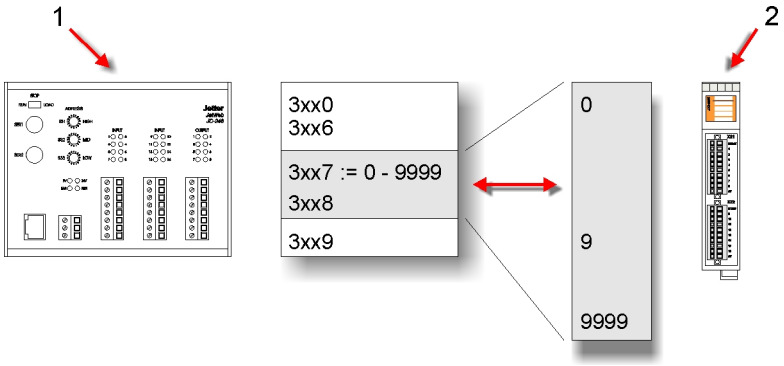


Figure 4: Indirect register access to JX3 modules

Above, indirect access to the JX3 module registers (2) has been illustrated. On the Jetter system bus, the JX3 modules can be accessed via register numbers 3xxz (1). With indirect access, the number of the JX3 module register is written to 3xx7. After this, the content of the JX3 module register can be accessed via 3xx8.

Register Numbering Dependent on the Controller

- For JC-24x controllers: Register number 3xxz
- For JC-647 controllers: Register number 3m03xxz
- For JC-800 controllers: Register number 4CM03xxz

Indirect Register Access in the Application Program

- Indirect access to JX3 module registers of a module may only be carried out within a task. If indirect access is made out of several tasks, the index may be overwritten after a task change.

Index for Indirect Register Access	
Module Register(s)	**7**
Description	At indirect register access to JX3 modules, the index contains the module register number. It functions as a pointer.
Access	Read and write access
Value range	0 ... 9999
Value after reset	9
Comment	After switching on, the index points to the module register "operating system version".

Data for Indirect Register Access	
Module Register(s)	**8**
Description	This module register is for reading, respectively writing, the value of the selected module register. The JX3-THI2-TC module copies the value of the actual module register to this register.
Access	Read and write access
Value range	32 bits
Value after reset	Operating System Release

Example: Indirect Reading of the Connected JX3 Modules

The number of JX3 modules connected to a JX3-BN-CAN is to be read. The number of connected JX3 modules has been written to module register 256 of the JX3-BN-CAN.

The I/O module number of JX3-BN-CAN is 33.

As a first step, JX3 module register number 256 has to be written into the index register. As a next step, the number of connected modules can be read via the data register.

```
VAR
      nm_Index : INT at %vl 3317;          //   Index register
      nm_Data : INT at %vl 3318;           //   Data register JX3-BN-CAN
END_VAR;

CONST
      c_RegNumModules = 256;               //   Parameter number
END_CONST;

TASK 0
      nm_Index := c_RegNumModules;
      IF
      nm_Data = 0                          //   No modules connected
      THEN
      // ...
      END_IF;
                                           //   ...
END_TASK;
```

Example of an Error: Indirect Register Access out of Two Tasks

This error example illustrates the results of indirect register access to a module out of two tasks.

- Task 0 checks the slave pointer for the minimum value of analog input 1
- Task 1 configures analog input 2 of a JX3-THI2-TC module

Sequence of the Sample Error

1. Task 0 sets the index to module register 1120 "**Slave pointer for minimum value**".
2. The following WHEN instruction checks the slave pointer for falling below a certain limit. The condition has not been met - a changeover to task 1 is made.
3. Task 1 sets the index to module register 1207 "**Analog Input Configuration**".
4. Analog input 2 is configured for voltage range 0 ... 10 V.
5. The following WHEN instruction delays until the analog input data are valid again.
6. There will be a changeover to the WHEN instruction in task 0.
7. The index has now been set to 1207; the WHEN instruction now checks module register 1207 "**Analog Input Configuration**". The result is not correct.

```
VAR
      nm_State : INT at %vl 3000;          //   Status register
      nm_Index : INT at %vl 3007;          //   Index register
      nm_Data : INT at %vl 3008;           //   Data register
END_VAR;

TASK 0
      nm_Index := 1120;                    //   Index to slave pointer
      WHEN
      nm_Data < 100                        //   Checking for the limit
      CONTINUE;
      // ...
END_TASK;

TASK 1
      nm_Index := 1207;                    //   Index to configuration
      nm_Data := 5;                        //   Measuring range 0..10 V
      WHEN
      BIT_SET(nm_State, 16)                //   wait, until data are valid
      CONTINUE;
      // ...
END_TASK;
```

5 Commissioning the JX3-THI2-TC Module

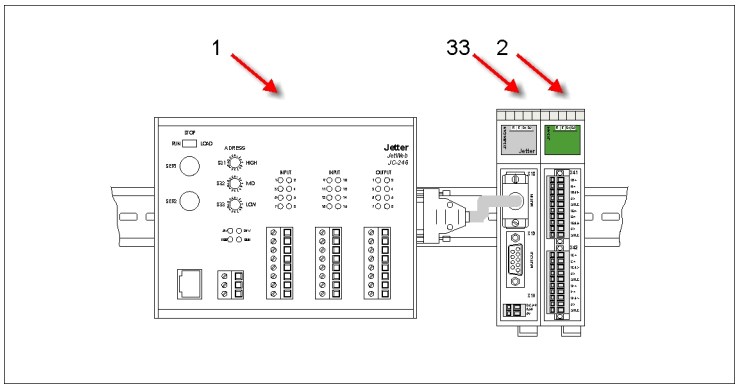
5.1 Approach to Commissioning the Module

Carry out the following steps for commissioning the JX3-THI2-TC module:

Steps to Commissioning	
Step	**Procedure**
1	Connect the thermocouple to terminal X41 or X42. When using hardware revision 00 of the JX3-THI2-TC, plug in the jumper between I1+ and U1-, as well as between U1- and 0V- for the first channel, or I2+ and U2-, as well as U2- and 0V for the second channel.
2	Configure the channel depending on the type of sensor: In module register 1y07 the sensor type can be set (e.g. thermocouple type K).
4	Having configured additional functions, wait until bit 16 "*Collective bit Validity*" in module register 0 "*Module Status*" has been set.
5	Read the digitized values of the temperature sensors via module registers 2 and 3: • Temperature input 1 -> module register 2 • Temperature input 2 -> module register 3

5.1.1 Fast Commissioning of the JX3-THI2-TC Module

Example: Commissioning the JX3-THI2-TC module



Both temperature sensors connected to a JX3-THI2-TC module (2) are to be configured.

- Channel # 1: TC type T
- Channel # 1: Ice point compensation OFF
- Channel # 2: TC type J
- Channel # 2: Show voltage value in module register 3
- All additional functions remain in their default settings.

```
VAR
      nm_State : INT at %vl 3000;          //   Status
      nm_TC_1 : INT at %vl 3002;           //   Temperature input 1
      nm_TC_2 : INT at %vl 3003;           //   Temperature input 2
      nm_Index : INT at %vl 3007;          //   Index
      nm_Data : INT at %vl 3008;           //   Data
       n_Local : INT at %vl 100;           //   User register
END_VAR;

TASK 0
      nm_Index := 1107;                    //   Module register address of
                                                channel # 1
      nm_Data := 10;                       //   Setting data to type T
      nm_Index := 1101;                    //   Module register address of
                                                channel # 1
      nm_Data := 191;                      //   Ice point data OFF
      nm_Index := 1207;                    //   Module register address of
                                                channel # 2
      nm_Data := 5;                        //   Setting data to TC type J
      nm_Index := 1201;                    //   Module register address of
                                                channel # 2
      nm_Data := 161;                      //   Setting data to voltage value

      WHEN
      BIT_SET (nm_State, 16)               //   Waiting for values to become
                                                valid
      CONTINUE;

      n_Local := nm_TC_1;                  //   Reading temperature input # 1
      n_Local := nm_TC_2;                  //   Reading temperature input # 2

END_TASK;
```

6 Digitizing Analog Values

6.1 Registers with Digitized Analog Value

Temperature input 1	
Module Register(s)	**2**
Description	Digitized value of temperature input channel # 1
Access	read
Value range	float
Value after reset	Value at analog input 1
Comment	The resolution is up to 0.0001 depending on the value. If the display is set to voltage, the last places are useful.

Temperature input 2	
Module Register(s)	**3**
Description	Digitized value of temperature input channel # 2
Access	read
Value range	float
Value after reset	Value at analog input 2
Comment	The resolution is up to 0.0001 depending on the value. If the display is set to voltage, the last places are useful.

6.2 Displaying the Temperature

The measured value per channel is displayed in degrees centigrads by default. The instruction registers can be used to have the temperature value displayed in Fahrenheit or the measured value in microvolts.

For converting temperatures the following formulas are used:

From Fahrenheit to degrees centigrades:

$$T_{in°C} = \frac{5}{9}(T_F - 32)$$

From degrees centigrades to Fahrenheit:

$$T_F = \frac{9}{5}T_{°C} + 32$$

Internal calculation:

The sensor voltage is converted according to DIN-EN 60584-1 into a temperature value by the JX3-THI2-TC module using a table.

6.3 Accuracy as a Function of Noise

Averaging and Noise						
Averaging	Slave pointer difference in µV	Rate of change (slow mode)	**TC type J**	**TC type K**	**TC type T**	**TC type R**
0	~ 100 µV	100 ms	+/- 1 °C	+/- 1.25 °C	+/- 1.3 °C	+/- 9 °C
5	~ 30 µV	500 ms	+/- 0.3 °C	+/-0.4 °C	+/-0.4 °C	+/- 2.9 °C
10	~ 20 µV	1,000 ms	+/- 0.2 °C	+/- 0.25 °C	+/- 0.25 °C	+/-1.8 °C
20	~ 17 µV	2,000 ms	+/- 0.15 °C	+/- 0.2 °C	+/- 0.2 °C	+/- 1.6 °C
40	~ 15 µV	4,000 ms	+/- 0.15 °C	+/- 0.2 °C	+/- 0.2 °C	+/-1.4 °C
64	~ 14 µV	6,400 ms	+/- 0.15 °C	+/- 0.2 °C	+/- 0.2 °C	+/-1.3 °C

We recommend to activate the moving average filter. With a 5-fold average value 1/5 of the new value is immediately considered in the reading. For the value to be competely be considered in averaging it takes 500 ms.

6.4 Variation at 10-fold Averaging

Temperature variation in °C per TC type									
Temperature in °C	**-200 °C**	**-100 °C**	**0 °C**	**100 °C**	**300 °C**	**500 °C**	**700 °C**	**900 °C**	**1100 °C**
Type J	0.7 °C	0.7 °C	0.5 °C	0.5 °C	0.5 °C	0.4 °C	0.4 °C	0.4 °C	0.9 °C
Type K	0.6 °C	0.8 °C	0.4 °C	0.8 °C	1.2 °C	0.9 °C	0.7 °C	0.8 °C	0.6 °C

7 Status and Instructions

Module status	
Module Register(s)	**0**
Description	Status and error messages of the module and of all analog channels
Access	read
Value range	32 bits, bit-coded
Value after reset	0x00100000 in faultless condition

The Meaning of the Individual Bits in the Module Status:

Bit 0: Hardware error

0 = No error

1 = There is a hardware error. Bit 0 can be set after a delay when bit 4 and bit 7 have been set.
The exact error cause can be determined by means of bit 4 through bit 7.

Bit 4: Error regarding reference values

0 = Reference values have been read correctly

1 = Hardware error at reading the stored reference values.
The error cannot be fixed by the user. The Jetter maintenance service has to be contacted.

Bit 6: Error regarding the A/D converter

0 = No error

1 = Hardware error at reading the analog input values of the A/D converter. The error can be acknowledged by means of instruction 5 “**Acknowledging hardware errors**”.
If the error remains after acknowledging, the hardware is defective. The Jetter maintenance service has to be contacted.

Bit 7: Error regarding internal voltages

0 = No error

1 = At least one internal voltage is or was not within the permitted limits.
The error bit is set by the JX3-THI2-TC module.

Bit 16: Collective bit "Validity"

0 = The analog input value in module registers 2 and 3 is not valid.
The average of at least one analog input is still to be calculated.
The collective bit "Validity" is reset for the following actions:
- The configurating procedure of the analog input is modified.
- The averaging procedure is modified.
- In case of an error regarding internal voltages
- In case of an error regarding the A/D converter

1 = Analog input values of all temperature channels are valid.

Bit 17: Collective bit "Cable Break"

0 = Both temperature channels are OK.

1 = At least one channel has exceeded the limit (converted into a temperature) so that break of at least one cable is likely. The bit is set by the JX3-THI2-TC module when the value falls below the limit. The bit is not reset by the module.
The bit must be reset by the user.

Bit 18 Collective Bit "Short Circuit"

0 = Both temperature channels are OK.

1 = At least one channel has exceeded the limit (converted into a temperature) so that short-circuit of at least one channel is likely. The bit is set by the JX3-THI2-TC module when the value falls below the limit. The bit is not reset by the module.
The bit must be reset by the user.

Bit 19: Collective bit "The lower limit has been fallen below"

1 = The configured lower limit of at least one analog input has been fallen below.
The bit is set by the JX3-THI2-TC module when the value falls below the limit. It is not reset by the module any more.
The bit must be reset by the user.

Bit 20: Collective bit "The upper limit has been exceeded"

1 = The configured upper limit of at least one analog input has been exceeded.
The bit is set by the JX3-THI2-TC module when the value exceeds the limit. It is not reset by the module any more.
The bit must be reset by the user.

Bit 23: Collective bit "Forcing"

0 = Forcing is not active

1 = Forcing is active for at least one analog input
Forcing can be activated, respectively deactivated, by instructions via the instruction register of the analog input.

Bit 30: Synchronous data exchange

0 = asynchronous

1 = Between the JX3-THI2-TC module and the bus head, respectively the JetControl JC-3xx, there is synchronous data exchange.

Instruction	
Module Register(s)	**1y01**
Description	Via instructions, various functions of the JX3-THI2-TC module can be activated.
Access	Read / write
Value range	32 bits
Value after reset	0

The module supports the following instructions:

105	**Fast Mode** Acquisition of a new reading in 10 ms.
106	**Slow Mode** Acquisition of a new reading in 100 ms.
107	**Display in °C** The reading is displayed in module register 2 or 3 in degrees centigrades
108	**Display in Fahrenheit** The reading is displayed in module register 2 or 3 in Fahrenheit
112	**Disabling the Channel** The channel is disabled (0 is displayed in module register 2)
113	**Re-enabling the channel** This instruction is for re-enabling the channel.
160	**The temperature value is displayed in module register 2 or 3** (Default) “opponent” of instruction 161.
161	**The temperature voltage of the thermocouple is displayed in module register 2 or 3 in µV.**
170	**Force value inactive** The temperature or voltage value is displayed in module register 2 or 3.
171	**Force value active** The value set in module register 1y04 is displayed.
180	**Displaying the temperature measured by the thermocouple at the measuring point.** (Default) “opponent” of instruction 18.
181	**Displaying the temperature measured by the thermocouple at the reference point (on the module).**

Displays the temperature of the JX3-THI2-TC module.

190	**Enabling ice point compensation** This instruction is for enabling ice point compensation. A relative temperature measured by the thermocouple is converted into an absolute temperatur by adding the so-called ice point.
191	**Disabling ice point compensation** This instruction is for disabling ice point compensation.

Temperature Input Status	
Module Register(s)	**1y00** **y : Number of the temperature input**
Description	Temperature input status messages
Access	read
Value range	16 bits, bit-coded
Value after reset	19140 (decimal) (Bit 2,6,7,9,11,14) set

The Meaning of the Individual Bits in the Status of the Temperature Input:

Bit 0: Displaying the reading in Fahrenheit or degrees centigrades

0 = The reading in module register 1y02 is displayed in degrees centigrades.

1 = The reading in module register 1y02 is displayed in Fahrenheit.

Bit 1: Ice point compensation ON/OFF

0 = Ice point compensation is disabled.

1 = Ice point compensation is enabled

Bit 5: Rapid Measuring Mode

0 = Slow measuring mode (approx. 100 ms for a new reading)

1 = Rapid measuring mode (approx. 10 ms for a new reading)

Bit 6: Values of this channel are valid

0 = Values of this channel are not valid

1 = Values of this channel are valid

Bit 7: Channel Calibration

0 = This channel is not calibrated

1 = This channel is calibrated

Bit 8: Force Value of a Channel

0 = Force value of this channel is inactive

1 = Force value of this channel is active

Bit 9: Displaying the termocouple temperature / ice point compensation

0 = Displaying the ice point compensation temperature

1 = Displaying the thermocouple temperature

Bit 11: Displaying the voltage / temperature value

0 = The voltage value is displayed in module register 30y2, respectively 30y3.

1 = The temperature value is displayed in module register 30y2, respectively 30y3.

Bit 12: Calibration Mode

0 = Calibraction mode is not active

1 = Calibration mode is active

Bit 14: Channel is active/inactive

0 = Channel has been deactivated

1 = Channel is active

Bit 15: Reset

0 = No reset / normal measuring mode

1 = Initiating a reset (synchronously)

7.1 JX3-THI2-TC: Allowed Thermocouple Types

TC type	No.	Material		Temp. (min)	Temp. (max)	Properties and application
		pos. side	neg. side			
(Pt)	1					
(Ni)	2					
B	3	Platinum-30% Rhodium (Pt30Rh)	Platinum-6% Rhodium (Pt6Rh)	+250 °C	+1,820 °C	Rarely used, sometimes in glass industry
E	4	Nickel-Chromium (NiCr)	Copper-Nickel (CuNi)	-200°C	+1,000°C	highest thermoelectric voltage per Kelvin; open measuring points in vacuum or slightly oxidizing atmospheres

TC type	No.	Material		Temp. (min)	Temp. (max)	Properties and application
J	5	Iron (Fe)	Copper-Nickel (CuNi)	-210°C	+1,200°C	Iron rusts at low temperatures and oxidizes at higher temperatures. Often used in plastics industry.
K	6	Nickel-Chromium (NiCr)	Nickel-Aluminum (NiAl)	-200°C	+1,372°C	Most common, great temperature range
N	7	Nickel-Chromium -Silicon (NiCrSi)	Nickel-Silicon (NiSi)	-200°C	+1,300°C	Insignificant spread. Stable output signal, high temperature cycling stability.
R	8	Platinum-13% Rhodium (Pt13Rh)	Platinum (Pt)	-50 °C	+1,768°C	For high temperature measurments. This type should be operated in a protective tube.
S	9	Platinum-10% Rhodium (Pt10Rh)	Platinum (Pt)	-50°C	+1,768°C	Similar to type R; smaller tolerance band and more cost intensive.
T	10	Copper (Cu)	Copper-Nickel (CuNi)	-200°C	+400°C	Insignificant spread; suitable for lower temperatures; good properties.

The sensor type has to be entered as number into register 1107 for channel # 1, and register 1207 for channel # 2.

The temperature limits have been defined acc. to DIN EN 60584-1:1995.

8 Additional Functions

8.1 Additional Functions - Overview

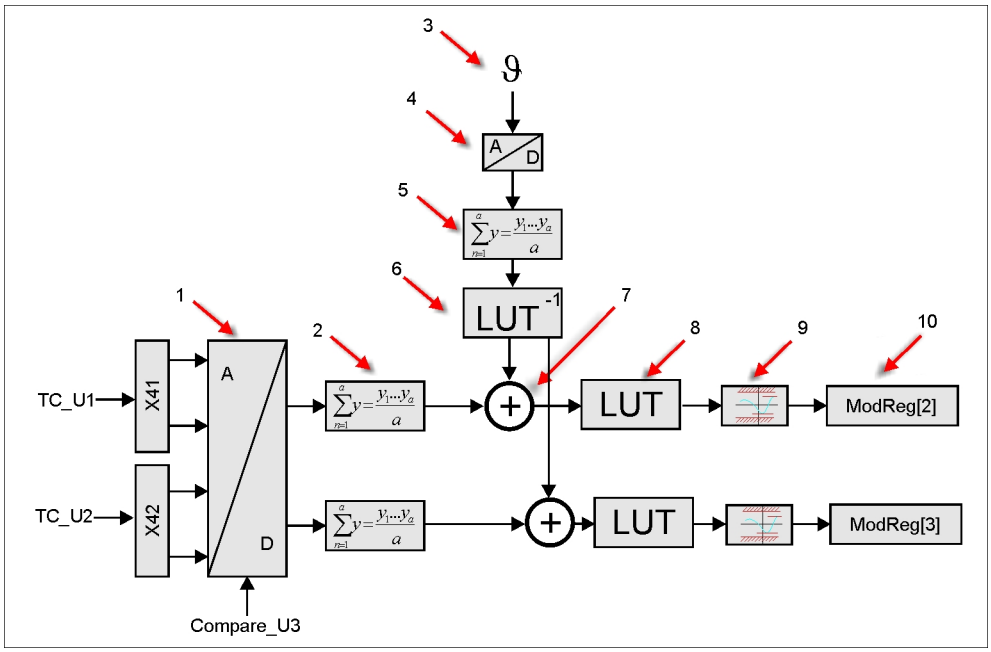
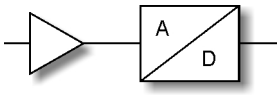


Figure 5: Functions of the JX3-THI2-TC module

Using additional functions, the digitized value of each temperature input can be adjusted to suit a specific application.

- These additional functions can separately be configured for each temperature input.
- Additional functions are processed in a certain order.

(1) A/D Conversion



1. The analog signal at terminals X41 and X42 is converted into a digital signal.
2. The digitized values are checked whether they exceed the measuring range in positive or negative direction (cable breakage, short circuit).

Relevant Module Registers

0 : Module status

1y00 : Status of analog input y

(2) Averaging of the temperature signal

$$\sum_{x=1}^{a} y = \frac{y_1 + y_2 + ... + y_a}{a}$$

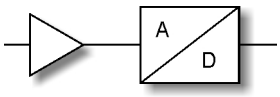
The result of A/D conversion is now subject to averaging.

Relevant Module Registers

0 : Module status
1y00 : Status of analog input y
1y06 : Averaging of analog input y

(3/4) Cold junction acquisition (3-8: Cold junction compensation)

ϑ



1. Acquisition of the cold junction temperature. The value exists as digital voltage value.
2. This value is converted into a temperature using a formula.

Relevant Module Registers

0: Module status
1y00 : Status of temperature input y
1y01: Command:

- 180/181: Thermocouple temperature/cold junction compensation is displayed.
- 190/191: Cold junction compensation ON / OFF

(5) Averaging of the reference value

$$\sum_{x=1}^{a} y = \frac{y_1 + y_2 + ... + y_a}{a}$$

Averaging the temperature on the JX3-THI2-TC module.

Relevant Module Registers

None

The maximum for moving average of the reference value is set to 64 values and cannot be changed.

(6) Cold junction conversion

Inverse look-up table (LUT)	The result y is converted into a voltage corresponding to the thermocouple type on the basis of a table. For this conversion, the tables defined in DIN-EN 60584-1 are used.

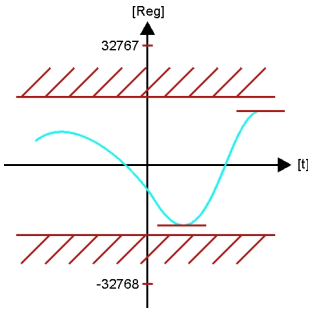
(7) Adding individual voltages to form a total voltage

Voltages of individual thermocouple voltages are added. The result is a total voltage.

(8) Converting the total voltage

Look-up table (LUT)	The total voltage is converted into a temperature value. For this conversion, the tables defined in DIN-EN 60584-1 are used.

(9) Monitoring of Limits / Slave Pointer



3. The average value is checked whether it is within the upper and lower limits.
   When a limit is exceeded, a bit is set in the status module register and in the diagnostics register of the temperature input.
4. The slave pointers are refreshed.

Relevant Module Registers

0 :	Module status
1y00 :	Status of analog input y
1y20 :	Minimum slave pointer value of analog input y
1y21 :	Maximum slave pointer value of analog input y

(10) Transfer

$y \Rightarrow \mathrm{CPU}$

5. The result of y is transferred to the controller as digitized analog value.

Relevant Module Registers

2 :	Temperature value of channel # 1
3 :	Temperature value of channel # 2

8.2 A/D Conversion

All analog input values are converted by a 16-bit A/D converter into a digital value.

8.3 Averaging

The JX3-THI2-TC module determines the moving average separately for each temperature input. With each incoming digitized reading the average of the last n measurements is determined. Averaging is carried out once the reading has been digitized.

Averaging results in a higher accuracy of the analog input signal. Short input signal peaks result only in slight changes in the value contained in module registers 2 and 3. The averaging function works like a 1st-order low-pass filter. The second effect of such a filter is that it reduces the rate of change of the result: If, for example, a new reading takes 100 ms in slow mode and averaging is set to 40, a change takes 4 s until all readings have passed through the filter. In the module register the change can already be seen on the basis of the changed values. With temperature measurements there are no input steps. Usually, temperature acquisition is a steady and slow process.

Averaging is carried out for the measured thermoelectric voltage of the sensors (two independent channels), as well as separately for the cold junction compensation as third channel included in averaging.

Averaging can be configured separately for each thermocouple input. When the configuration is changed, the data of the temperature input become invalid. Bit 16 of the *Collective bit Validity* in register 0 *Module Status* is reset. Averaging starts anew.

Averaging - Analog Channel	
Module Register(s)	**1y06 y : Number of the Analog Input**
Description	Configuration of averaging feature
Access	Read / write
Value range	0 ... 64
Value after reset	10

The following averaging types can be configured:

n =	
0, 1	No averaging
2 ... 64	n-fold averaging

8.4 Monitoring of Limits

Lower limit	
Module Register(s)	**1y08 y : Number of the temperature input**
Description	Setting a new lower limit. With each conversion the JX3-THI2-TC module checks whether the upper limit has been exceeded. The value is represented as x factor 1,000. Example: -50,700 equals to -50.7 °C
Input	Temperature value x factor 1,000.
Access	Read / write
Value range	float
Value after reset	-50.000

Upper Limit	
Module Register(s)	**1y09 y : Number of the temperature input**
Description	Setting a new upper limit. With each conversion the JX3-THI2-TC module checks whether the upper limit has been exceeded. The value is represented as x factor 1000. Example: +680,700 equals to +680.7 °C
Input	Temperature value x factor 1,000.
Access	Read / write
Value range	float
Value after reset	+450.000

8.5 Slave Pointer

With each conversion the JX3-THI2-TC module updates the slave pointer for the lower and upper limit. The slave pointers (red line on the diagram) show the lowest and highest measured values. The slave pointer contents get lost when the module is switched off.

Slave pointers are checked following averaging.

Slave Pointer for Minimum Value	
Module Register(s)	**1y20 y : Number of the Analog Input**
Description	This module register contains the lowest measured value.
Access	Read / write
Value range	Value x factor 1,000, that is, 123,456 corresponds to 123,456 Ω
Value after reset	0

Slave Pointer for Maximum Value	
Module Register(s)	**1y21 y : Number of the Analog Input**
Description	This module register contains the highest measured value.
Access	Read / write
Value range	Value x factor 1,000, that is, 123,456 corresponds to 123,456 Ω
Value after reset	0

8.6 Transfer to the Controller

The digitized values are transferred to the controller from two module registers.

- Temperature input # 1, resp. channel # 1 -> module register 2
- Temperature input # 2, resp. channel # 2 -> module register 3

9 Oscilloscope

9.1 Operating Principle

The module JX3-THI2-TC features an integrated oscilloscope function. Using this function, certain values can be recorded by the JX3-THI2-TC module over a given time. The values are recorded on the module at a minimum interval of 1 milliseconds without stressing the CPU. Then, the stored values can be loaded into JetSym and displayed as graphs. This function allows you to easily calibrate the module.

9.1.1 Oscilloscope Mode - Technical Data

Oscilloscope - Technical Data	
Module registers which can be recorded	2 : Temperature input channel # 1 3 : Temperature input channel # 2
Time Base	1 ms ... 65,535 ms
Number of readings	2 values simultaneously: 300 each 1 value simultaneously: 600
Module registers to which a trigger condition can be assigned	2 : Temperature input channel # 1 3 : Temperature input channel # 2

9.2 Recordings via Oscilloscope

Starting from JetSym version 4.00 data can be recorded on a JX3 module using the oscilloscope feature. Create in JetSym workspace within the folder **Oscilloscope** a new **extended JetSym oscilloscope** file. This is done by selecting **New file...** from the shortcut menu.

Recording is carried out in **compatible mode**. In order to record values, select on the tab **Sampling** JX3 Series as module. The slot number corresponds to the I/O module number on the system bus. In our example, the I/O module number of our JX3-THI2-TC module is 2.

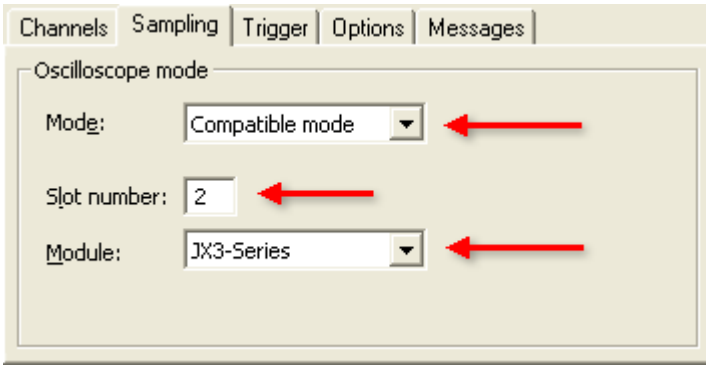


Figure 6: Settings for JX3 modules

When you open the oscilloscope file, the following window is displayed:

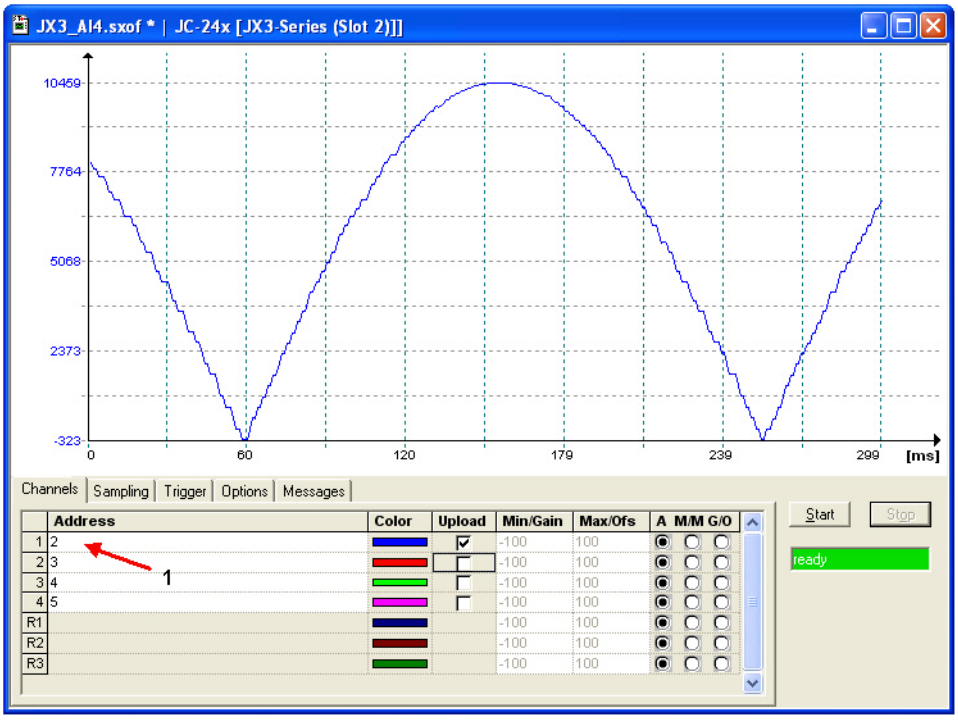


Figure 7: Recording an input signal

The module register numbers to be recorded have to be entered into column **Address** (1). When pressing the key **Start**, the module starts to record 300 values with an interval of 1 millisecond. When recording is finished, JetSym loads the data and displays them as a diagram.

9.3 Triggering a Recording Session

When a recording has been triggered, the JX3-THI2-TC module is permanently checking whether the trigger condition is fulfilled. Once the condition is fulfilled, the module starts the recording process and fills the memory with the configured readings.

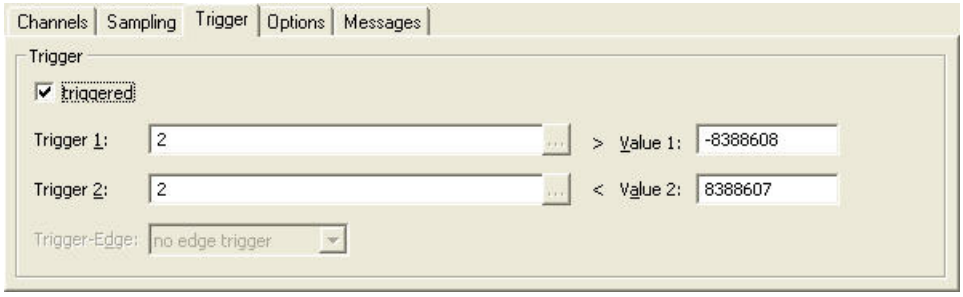
The recording result can be read out in JetSym and displayed as diagram.

Trigger Condition

Module register[trigger 1] > value[trigger1] and module register[trigger 2] < value[trigger2]

Example: Configuring a Trigger Record in Oscilloscope Mode

The JX3-THI2-TC module is to start the recording of readings once in module register 2 a value between 10,000 and 15,000 is measured.



Module register number 2 has to be entered as trigger 1 and trigger 2 for analog input 1. The trigger values have to be entered, too. Once the trigger is launched, the module starts monitoring the trigger condition. Once the trigger condition is fulfilled, data can be loaded into JetSym and displayed as diagram.

9.4 Module Registers - Overview

Apart from JetSym, the oscilloscope mode can also be activated directly from the application program via module registers. This allows the user to initiate a recording session depending on the application program. When doing so, data are uploaded and displayed in JetSym later.

Notice!

The recorded data get lost when the module is switched off.

Oscilloscope Mode Instructions	
Module Register(s)	**9740**
Description	These instructions are for controlling the oscilloscope functions on the module.
Access	Read / write
Value range	0 ... 3
Value after reset	0

The following instructions are available for oscilloscope mode:

1	**Starting a recording session** The module starts recording the previously configured values. Once the internal memory is stored with readings, the module stops recording.
2	**Stopping a recording session** The stop instruction can be used to stop an ongoing recording session.
3	**Starting a recording session once a trigger condition is fulfilled** The module starts monitoring the trigger condition. Once the trigger condition is fulfilled, the module starts recording the values.

Parameter Index for Oscilloscope Mode	
Module Register(s)	**9741**
Description	The parameter index is for selecting the parameter(s) for oscilloscope mode. The parameter value can directly be be read out of module register 9742, or entered into module register 9742.
Access	Read / write
Value range	0 ... 23

Oscilloscope Mode Parameters	
Module Register(s)	**9742**
Description	This module register contains the value of oscilloscope mode parameters. The parameter is selected via parameter index (module register 9741).
Access	Read / write
Value range	32 bits
Value after reset	0

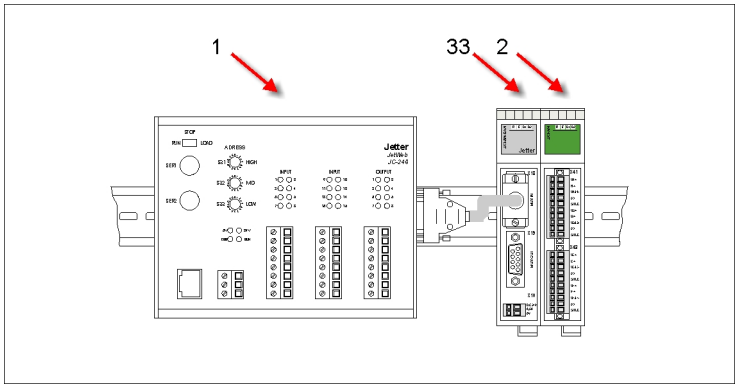
Oscilloscope Mode Parameters:

0	**Status (read-only)** Bit 0: 1 = Recording is running Bit 1: 1 = Trigger active
2	**Max. number of channels** After reset, this parameter contains the maximum number of channels which can be recorded. The number of channels can be reduced by modifying this parameter. When doing so, the number of readings per channel increases accordingly. Value range: 1, 2
3	**Max. number of readings per channel (read-only)** Once a recording session is started, the module stores the readings for the configured channels. When the maximum number is reached, the recording session stops. The maximum number of readings depends on the number of channels which have been configured.
4	**Minimum sampling interval (read-only)** This parameter returns the minimum sampling interval in milliseconds.
10	**Sampling interval** The sampling interval defines the intervals at which readings are recorded. The interval between two recordings (in milliseconds) results from the product of minimum sampling interval and sampling interval. Value range: 1 ... 65,535
11	**Number of the module register for oscilloscope channel # 1** Value range: 2, 3
12	**Number of the module register for oscilloscope channel # 2** Value range: 2, 3
20	**Number of the module register for oscilloscope trigger # 1** Value range: 2, 3
21	**Value for trigger # 1**

	Value range: -50 ... +800
22	**Number of the module register for oscilloscope trigger # 2** Value range: 2, 3
23	**Value for trigger # 2** Value range: -50 ... +800

9.5 Recordings via Application Program

Example: Starting a recording session from the application program



The readings at analog input 2 of a JX3-THI2-TC module are to be recorded in the application program starting from a certain time. To do so, the oscilloscope function must be configured and started via module registers.

The overall duration of this recording session is 6 seconds. Thus, the sampling interval must be set to 20 milliseconds.

- The JX3-THI2-TC module has got I/O module number 2 on the Jetter system bus.

```
VAR
      nm_Index : INT at %vl 3007;          //   Index
      nm_Data : INT at %vl 3008;           //   Data
END_VAR;

CONST                                      //   Numbers of JX3 mod. reg.
      c_OsziCommand = 9740;
      c_OsziParaIdx = 9741;
      c_OsziPara = 9742;
END_CONST;

TASK 0
                                           //   ...
      nm_Index := c_OsciParaIdx;           //   Osci parameter index
      nm_Data := 10;                       //   Setting the sampling interval
      nm_Index := c_OsciPara;              //   Osci parameter
      nm_Date := 20;                       //   Sampling interval set to 20 ms
      nm_Index := c_OsciCommand;           //   Osci instruction
      nm_Date := 1;                        //   Starting a recording session
                                           //   After recording load values
                                           //   in JetSym
END_TASK;
```

10 Forcing Analog Inputs

10.1 JX3-THI2 - Functional Principle of Forcing

When forcing, the value contained in module register 1y04 *Force Value* is transferred to the controller instead of the analog value of a connected sensor. This way, the behavior of the connected sensor can be simulated during commissioning. This option allows also to test exceptional situations which do not occur during normal operation.

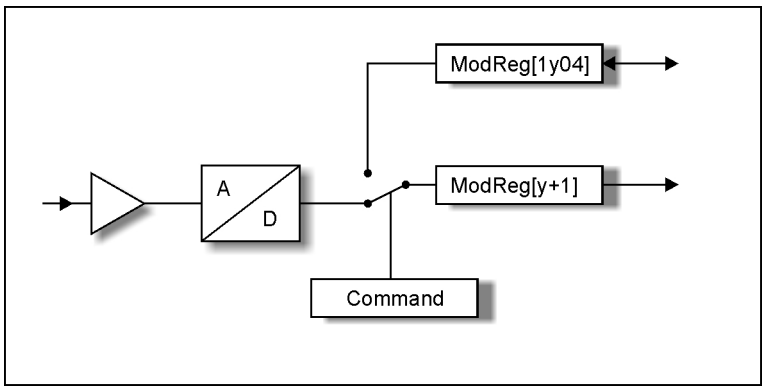


Figure 8: The Functioning Principle of Forcing

When the forcing function is used, the connection to the A/D converter in the module gets interrupted. The module copies the value contained in module register 1y04 *Force Value* into module register y+1 *Analog Input Value*. Now, the controller reads the fake analog input from the JX3-THI2-TC module.

All additional functions of the module JX3-THI2-TC are fully maintained. Only the check whether the measuring range has been exceeded is disabled. The forcing function can be configured for each analog input separately.

When the forcing function is activated and deactivated, the data of the analog input become invalid. Bit 16 of the *Collective bit Validity* in module register 0 *Module Status* is reset. Averaging starts anew.

10.2 Forcing - Module Register

Commands for Temperature Input	
Module Register(s)	**1y01 y : Number of the Analog Input**
Description	Via commands, various functions of the temperature input can be activated or deactivated.
Access	Read / write
Value range	8 bits
Value after reset	0

For the analog input the following commands are available:

170	**Deactivation of the forcing function** The values of the A/D converter for analog input y are transferred to the controller. When the forcing function is deactivated, the data of the analog input become invalid. Bit 16 of the *Collective bit Validity* in module register 0 *Module Status* is reset. Averaging starts anew.
171	**Activation of the forcing function** The values of module register 1y04 *Force Value* for analog input y are transferred to the controller. When the forcing function is activated, the data of the analog input become invalid. Bit 16 of the *Collective bit Validity* in module register 0 *Module Status* is reset. Averaging starts anew.

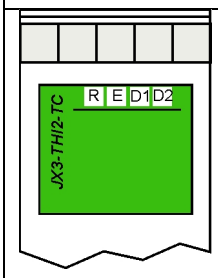
Force Value	
Module Register(s)	**1y04 y : Number of the analog input**
Description	Fake value of analog input y
Access	Read / write
Value range	Value x factor 1000. Example: 123456 equals to 123,456°C
Value after reset	0

11 Diagnostics and Administration

11.1 JX3-THI2-TC: Behavior in Case of Errors:

11.2 Diagnostic Indicators (LEDs)

The module JX3-THI2-TC features four LEDs to indicate different conditions.

LEDs				
View	**LED**	**Color**	**Status**	**Function**
	R	green	off	Logic supply of the module is not OK
			is lit	Logic supply of the module is OK
	E	red	off	Communication with the bus head, respectively with the JC-3xx is active
			is lit	No communication
	D1	red	is lit	Hardware error
	D2	red	flashing shortly	No valid operating system on the JX3-THI2-TC module available. Carry out an update.
	D2	red	is lit	Cable break or short-circuit of thermal sensor of at least one channel.
	D1 / D2	red	Both LEDs are flashing	The operating system update is active

11.3 Diagnostics via JX3 Module Registers

Module Status	
Module Register(s)	**0**
Description	Status and error messages of the module and of all analog channels
Access	read
Value range	32 bits, bit-coded
Value after reset	0x00100000 in faultless condition

The Meaning of the Individual Bits in the Module Status:

Bit 0: Hardware error

0 = No error

1 = There is a hardware error. Bit 0 can be set after a delay when bit 4 and bit 7 have been set.
The exact error cause can be determined by means of bit 4 through bit 7.

Bit 4: Error regarding reference values

0 = Reference values have been read correctly

1 = Hardware error at reading the stored reference values.
The error cannot be fixed by the user. The Jetter maintenance service has to be contacted.

Bit 6: Error regarding the A/D converter

0 = No error

1 = Hardware error when reading the analog input values of the A/D converter. The error can be acknowledged by means of instruction 5 “**Acknowledging hardware errors**”.
If the error remains after acknowledging, the hardware is defective. The Jetter maintenance service has to be contacted.

Bit 7: Error regarding internal voltages

0 = No error

1 = At least one internal voltage exceeds or exceeded the permitted limits.
The error bit is set by the JX3-THI2-TC module.

Bit 16: Collective bit "Validity"

0 = The analog input value in module registers 2 and 3 is not valid.
The average of at least one analog input is still to be calculated.
The collective bit "Validity" is reset for the following actions:

- The configurating procedure of the analog input is modified.
- The averaging procedure is modified.
- In case of an error regarding internal voltages
- In case of an error regarding the A/D converter

1 = Analog input values of all temperature channels are valid.

Bit 17: Collective bit "Cable Break"

0 = Both temperature channels are OK.

1 = At least one channel has exceeded the limit (converted into a temperature) so that break of at least one cable is likely. The bit is set by the JX3-THI2-TC module when the value falls below the limit. The bit is not reset by the module.
The bit must be reset by the user.

Bit 18 Collective bit "Short Circuit"

0 = Both temperature channels are OK.

1 = At least one channel has exceeded the limit (converted into a temperature) so that short-circuit of at least one channel is likely. The bit is set by the JX3-THI2-TC module when the value falls below the limit. The bit is not reset by the module.
The bit must be reset by the user.

Bit 19: Collective bit "The lower limit has been fallen below"

1 = The value of at least one analog input has fallen below the configured lower limit.
The bit is set by the JX3-THI2-TC module when the value falls below the limit. It is not reset by the module any more.
The bit must be reset by the user.

Bit 20: Collective bit "The upper limit has been exceeded"

1 = The configured upper limit of at least one analog input has been exceeded.
The bit is set by the JX3-THI2-TC module when the value exceeds the limit. It is not reset by the module any more.
The bit must be reset by the user.

Bit 23: Collective bit "Forcing"

0 = Forcing is not active

1 = Forcing is active for at least one analog input
Forcing can be activated, respectively deactivated, by instructions via the instruction register of the analog input.

Bit 30: Synchronous data exchange

0 = asynchronous

1 = Between the JX3-THI2-TC module and the bus head, respectively the JetControl JC-3xx, synchronous data exchange takes place.

Temperature Input Status	
Module Register(s)	**1y00 y : Number of the temperature input**
Description	Temperature input status messages
Access	read
Value range	16 bits, bit-coded
Value after reset	19140 (decimal) (Bit 2,6,7,9,11,14) set

The Meaning of the Individual Bits in the Status of the Temperature Input:

Bit 0: Displaying the reading in Fahrenheit or degrees centigrades

0 = The reading in module register 1y02 is displayed in degrees centigrades.

1 = The reading in module register 1y02 is displayed in Fahrenheit.

Bit 1: Ice point compensation

0 = Ice point compensation is disabled.

1 = Ice point compensation is enabled

Bit 5: Rapid Measuring Mode

0 = Slow measuring mode (approx. 100 ms for a new reading)

1 = Rapid measuring mode (approx. 10 ms for a new reading)

Bit 6: Values of this channel are valid

0 = Values of this channel are not valid

1 = Values of this channel are valid

Bit 7: Channel Calibration

0 = This channel is not calibrated

1 = This channel is calibrated

Bit 8: Force Value of a Channel

0 = Force value of this channel is inactive

1 = Force value of this channel is active

Bit 9: Displaying the thermocouple/ice point temperature

0 = Displaying the ice point temperature

1 = Displaying the thermocouple temperature

Bit 11: Displaying the voltage / temperature value

0 = The voltage value is displayed in module register 30y2, respectively 30y3.

1 = The temperature value is displayed in module register 30y2, respectively 30y3.

Bit 12: Calibration Mode

0 = Calibraction mode is not active

1 = Calibration mode is active

Bit 13: Potentiometer mode

0 = Potentiometer mode is not active

1 = Potentiometer mode is active

Bit 14: Channel is active/inactive

0 = Channel has been deactivated

1 = Channel is active

Bit 15: Reset

0 = No reset / normal measuring mode

1 = Initiating a reset (synchronously)

Operating System Release	
Module Register(s)	**9**
Description	The operating system release of the JX3-THI2-TC module in the "Major.Minor.Branch.Build" format
Access	read
Value range	32 bits
Value after reset	Up-to-date operating system release
Comment	A released operating system can be recognized by both Branch and Build having got value zero. For displaying the operating system release number in the setup window of JetSym, please select the format "IP address".

A new operating system can be transferred to the JX3-THI2-TC module via JetSym. Operating systems are available for download on the web site of Jetter AG.

11.4 Electronic Data Sheet (EDS)

Various product relevant data have been stored to a remanent memory in the individual JX3 modules. These data include serial number, hardware revision etc. These data are integrated into the electronic data sheet (EDS).

Survey of the EDS Registers		
Register(s)	**Description**	**Remanent registers**
10040 ... 10041	EDS data selection	no
10042 ... 10105	EDS data	yes (read only)

Pointer to I/O-Module Number for EDS	
Register(s)	**10040**
Description	This register is used for selecting a JX3 module the EDS data of which are to be accessed.
Access	Read / write
Value range	2 ... 63
Value after reset	33

Pointer to EDS Page	
Register(s)	**10041**
Description	By means of this register, an EDS page of the JX3 module is selected.
Access	Read / write
Value range	0 ... 1
Value after reset	0

The EDS data can be read by the controller via registers. Writing data is not possible. In order to read the EDS files, the I/O module number has to be entered into register 10040. Then, the respective EDS page has to be entered into register 10041. The EDS data are then available in registers starting from 10042 depending on the selected EDS page. When reading EDS data in JetSym the corresponding type must be selected.

EDS Page 0 - Identification		
Register(s)	**Type**	**Description**
10042	int	Version of the EDS page
10043	int	Module code
10044 ... 10054	string	Module name
10055	int	Hardware version
10056	int	Hardware version

EDS Page 1 - Production		
Register(s)	**Type**	**Description**
10042	int	Version of the EDS page
10043 ... 10049	string	Module serial number
10050	int	Production date, day
10051	int	Date of production, month
10052	int	Production date, year

Example: Reading the EDS via the JetSym Setup Window

For reading the EDS via setup window of JetSym, the structure of the EDS pages is defined as a type. After this, three variables are defined basing on the type.

```
TYPE
      JX3_EDS:                                  //   Register EDS selection
      STRUCT
            ns_Module : INT;
            ns_page : INT;
      END_STRUCT;
      JX3_EDS0:                                 //   Registers of EDS page 0
      STRUCT
            ns_Version : INT;
            ns_Code : INT;
            s_Name : STRING[31];
            ns_PCB_Rev : INT;
            ns_PCB_Opt : INT;
      END_STRUCT;
      JX3_EDS1:                                 //   Registers of EDS page 1
      STRUCT
```

```
            ns_Version : INT;
            s_Sernum : STRING[19];
            ns_TS_Day : INT;
            ns_TS_Month : INT;
            ns_TS_Year : INT;
      END_STRUCT;
END_TYPE;

VAR
      st_EDS : JX3_EDS at %vl 10040;          //   EDS selection
      st_EDS0 : JX3_EDS0 at %vl 10042;        //   EDS Page 0
      st_EDS1 : JX3_EDS1 at %vl 10042;        //   EDS Page 1
END_VAR;
```

EDS.sts | JC-24x V3.23 (JETIP:192.168.10.46) - stopped

	Name	Number	Content	Type	Comment
1	st_EDS.ns_Module	10040	9	int	
2	st_EDS.ns_Page	10041	0	int	
3					
4	// --- EDS-Page 0 ---				
5	st_EDS0.ns_Version	10042	0	int	
6	st_EDS0.ns_Code	10043	300	int	
7	st_EDS0.s_Name	10044	"JX3-DI16"	string	
8	st_EDS0.ns_PCB_Rev	10055	1	int	
9	st_EDS0.ns_PCB_Opt	10056	0	int	
10					

Figure 9: EDS Page 0 displayed in the Setup pane

In the setup pane above, EDS Page 0 (st_EDS.ns_Page) is displayed by the JX3 module of I/O module number 9 (st_EDS.ns_Module).

Appendix

12 Recent Revisions

The comments on signals U1- and I1- of terminal X41, as well as on signals U2- and I2- of terminal X42 have been mixed up.

13 Module Registers - Overview

13.1 Overview - JX3-THI2-TC Module Registers

Overview - JX3 Module Registers		
Module Register(s)	**Description**	**Remanent registers**
0	Status	no
2	Temperature value of channel # 1 as float	no
3	Temperature value of channel # 2 as float	no
7 ... 8	Module register for indirect access	no
9	Operating System Release	no
1100 ... 1199	Module register for channel # 1	no
1200 ... 1299	Module register for channel # 2	no
9470 ... 9474	Oscilloscope	no

13.2 Table - JX3-THI2-TC Module Registers

Register Table		
Direct Access via Jetter System Bus		
Module Register(s)	**Description**	**1) Value Range 2) Reset Value 3) Cross Reference**
0	Module Status	1) 32-bit 2) 19010 3) (on page 58)
2	Temperature value of channel # 1	1) float 2) Input value 3) (on page 33)
3	Temperature value of channel # 2	1) float 2) Input value 3) (on page 33)
7	Index for indirect access to module registers	1) 0 ... 9.999 2) 9 3) (on page 27)
8	Datum for indirect access to module registers	1) 32-bit 2) Version ***3)*** (on page 28)
9	OS Rev. #	1) 32-bit 2) Version ***3)*** (on page 61)
Indirect Access via Jetter System Bus - Analog input y: 1 ... 4		
Module Register(s)	**Description**	**1) Value Range 2) Reset Value 3) Cross Reference**
1y00	Status of analog input	1) 32-bit 2) Diagnostic function ***3)*** (on page 37)
1y01	Instruction for analog input	1) 32-bit 2) 0 ***3)*** (on page 37)
1y06	Averaging	1) 0..64 2) 20 ***3)*** (see "Averaging" on page 44)
1y08	Lower limit	1) Value x 1,000 2) 0 ***3)*** (on page 45)
1y09	Upper Limit	1) Value x 1,000 2) 0 ***3)*** (on page 45)

1y20	Slave Pointer for Minimum Value	1) Value x 1,000 2) 0 ***3)*** (on page 46)
1y21	Slave Pointer for Maximum Value	1) Value x 1,000 2) 0 ***3)*** (on page 46)
Indirect Access via Jetter System Bus - Oscilloscope		
Module Register(s)	**Description**	**1) Value Range 2) Reset Value 3) Cross Reference**
9470	Oscilloscope Mode Instructions	1) 8-bit 2) 0 ***3)*** (on page 50)
9471	Parameter Index for Oscilloscope Mode	1) 8-bit 2) 0 ***3)*** (on page 50)
9472	Oscilloscope Mode Parameters	1) 32-bit 2) 0 ***3)*** (on page 51)

14 Design

14.1 Physical Dimensions

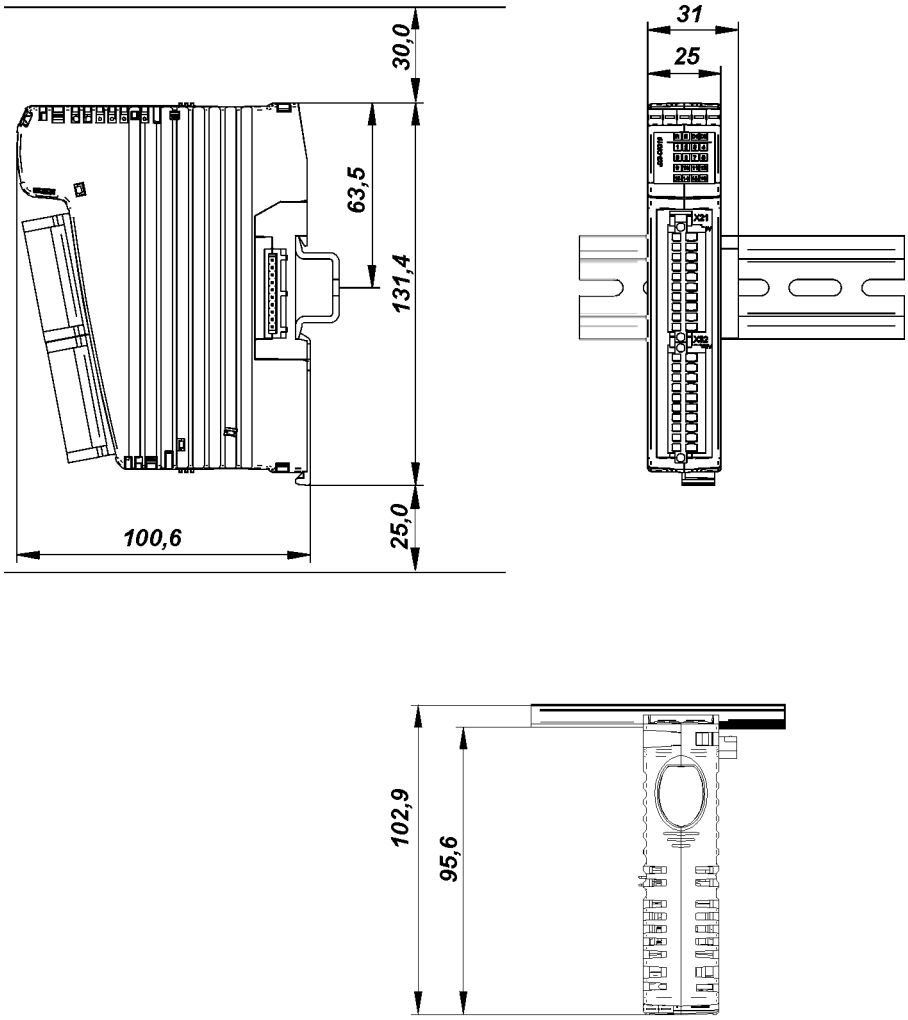


Figure 10: Physical dimensions in mm, mounted on DIN-rail EN 50022 - 35 x 7.5

Notice!

At mounting the JX3 modules, a minimum clearance above and below must be maintained. The minimum clearance above is 30 mm, the minimum clearance below is 25 mm.

The clearance is needed for dismounting the JX3 module from the JX3 backplane module.

The first JX3 module requires a space of 31 mm width. Each further JX3 module increases the width of a JX3 station by 25mm.

The JX3 modules must be mounted in vertical position. Only when vertically mounted, optimum heat dissipation from the modules is ensured.

Design	
Dimensions (H x W x D in mm)	131 x 31 x 100
Weight	160 g
LED sheeting	Color: RAL 6018, yellow-green
JX3 module enclosure	Plastic, Color: RAL 7035, light grey
JX3-Backplane module	Plastic, Color: RAL 5002, ultramarine blue
Installation	On DIN-rail EN 50022 - 35 x 7.5 or EN 50022 - 35 x 15

14.2 JX3-THI2-TC Terminals

The JX3-THI2-TC module is equipped with the following terminals:

X41	Terminal for temperature sensor, channel # 1 10-pin male connector, 3.5 mm pitch, with an integrated thread for the female connector
X42	Terminal for temperature sensor, channel # 2 10-pin male connector, 3.5 mm pitch, with an integrated thread for the female connector

15 Operating Conditions

15.1 Environment and Mechanics

Operating Parameters - Environmental Data		
Parameter	**Value(s)**	**Standard**
Operating Temperature Range	0 ... + 50 °C	
Storage Temperature Range	-40 ... + 70 °C	DIN EN 61131-2 DIN EN 60068-2-1 DIN EN 60068-2-2
Air humidity	10 ... 95 % (non-condensing)	DIN EN 61131-2
Pollution Degree	2	DIN EN 61131-2
Corrosion Immunity/Chemical Resistance	No special protection against corrosion. Ambient air must be free from higher concentrations of acids, alcaline solutions, corrosive agents, salts, metal vapours, or other corrosive or electroconductive contaminants	
Max. Operating Altitude	2,000 m	DIN EN 61131-2

Operating Parameters - Mechanical Data		
Parameter	**Value(s)**	**Standard**
Free Falls Withstanding Test	Free fall at ... Shipping container 1 m Product packaging 0.3 m	DIN EN 61131-2 DIN EN 60068-2-32
Vibration Resistance	5 Hz - 9 Hz: 3.5 mm amplitude 9 Hz - 150 Hz: 1 g Acceleration 1 octave/minute, 10 frequency sweeps (sinusoidal), all 3 spatial axes	DIN EN 61131-2 DIN EN 60068-6-2
Shock Resistance	15 g occasionally, 11 ms, sinusoidal half-wave, 3 shocks in the directions of all three spatial axes	DIN EN 61131-2 DIN EN 60068-2-27
Class of Protection	IP 20	DIN EN 60529
Mounting Position	Vertical position, snapped on DIN rail	

15.2 Enclosure

Operating Parameters - Electrical Safety		
Parameter	**Value(s)**	**Standard**
Protection Class	III	DIN EN 61131-2
Dielectric Test Voltage	Functional ground is connected to chassis ground internally.	DIN EN 61131-2
Protective Connection	0	DIN EN 61131-2
Overvoltage Category	II	DIN EN 61131-2

Operating Parameters - EMC (Emitted Interference)		
Parameter	**Value(s)**	**Standard**
Enclosure	Frequency band 30-230 MHz, limit 30 dB (µV/m) at 10 m distance Frequency band 230-1,000 MHz, limit 37 dB (µV/m) at 10 m distance (class B)	DIN EN 61000-6-3 DIN EN 61000-6-4 DIN EN 55011

Operating Parameters - EMC (Immunity to Interference)		
Parameter	**Value(s)**	**Standard**
Magnetic Field with mains frequency	50 Hz 30 A/m	DIN EN 61131-2 DIN EN 61000-6-2 DIN EN 61000-4-8
RF field, amplitude-modulated	Frequency band: 80 MHz – 2 GHz Test field strength: 10 V/m AM 80 % at 1 kHz Criterion A	DIN EN 61131-2 DIN EN 61000-6-2 DIN EN 61000-4-3
ESD	Discharge through air: Test peak voltage 8 kV Contact Discharge: Test peak voltage 4 kV Criterion A	DIN EN 61131-2 DIN EN 61000-6-2 DIN EN 61000-4-2

15.3 DC Power Supply Inputs and Outputs

Operating Parameters - EMC (Emitted Interference)		
Parameter	**Value(s)**	**Standard**
Signal and control interface DC power supply inputs and outputs	Frequency bands: 0.15 to 0.5 MHz, limit 40 to 30 dB 0.5 to 30 MHz, limit 30 dB (class B)	DIN EN 61000-6-3

Operating Parameters - EMC (Immunity to Interference)		
Parameter	**Value(s)**	**Standard**
RF, asymmetric	Frequency band 0.15 – 80 MHz Test voltage 3 V AM 80 % at 1 kHz Source impedance 150 Ohm Criterion A	DIN EN 61131-2 DIN EN 61000-6-2 DIN EN 61000-4-6
Bursts	Test voltage 2 kV tr/tn 5/50 ns Repetion frequency 5 kHz Criterion A	DIN EN 61131-2 DIN EN 61000-6-2 DIN EN 61000-4-4
Voltage surges, asymmetric (line to earth), symmetrical (line to earth)	tr/tn 1.2/50 µs Common-mode interference voltage 1 kV Series-mode interference voltage 0.5 kV	DIN EN 61131-2 DIN EN 61000-6-2 DIN EN 61000-4-5

15.4 Shielded Data and I/O Lines

Operating Parameters - EMC (Immunity to Interference)		
Parameter	**Value(s)**	**Standard**
Asymmetric RF, amplitude-modulated	Frequency band 0.15 – 80 MHz Test voltage 3 V AM 80 % at 1 kHz Source impedance 150 Ohm Criterion A	DIN EN 61131-2 DIN EN 61000-6-2 DIN EN 61000-4-6
Burst (Bursts)	Test voltage 1 kV tr/tn 5/50 ns Repetion frequency 5 kHz Criterion A	DIN EN 61131-2 DIN EN 61000-6-2 DIN EN 61000-4-4
Voltage surges, asymmetric (line to earth)	tr/tn 1.2/50 µs Common mode launching 1 kV	DIN EN 61131-2 DIN EN 61000-6-2 DIN EN 61000-4-5

Operating Parameters - EMC (Immunity to Interference of Functional Ground Connection)		
Parameter	**Value(s)**	**Standard**
RF, asymmetric	Frequency band 0.15 – 80 MHz Test voltage 3 V AM 80 % at 1 kHz Source impedance 150 Ohm Criterion A	DIN EN 61131-2 DIN EN 61000-6-2 DIN EN 61000-4-6
Bursts	Test voltage 1 kV tr/tn 5/50 ns Repetion frequency 5 kHz Criterion A	DIN EN 61131-2 DIN EN 61000-6-2 DIN EN 61000-4-4

16 Technical Data

JX3 System Bus	
Logic voltage of backplane	DC + 5 V (-15 % ... +10 %)
Current consumption - logic voltage of backplane	typical: 210 mA
Additional voltage of backplane	DC + 24 V (-15 % ... +20 %)
Current consumption - logic voltage of backplane	-
Nominal power absorbed from the JX3 system bus	1,050 mW

Electrical Data - Temperature Inputs	
Accuracy	+/- 0.5 °C within the range of -50 .. +450°C; +/- 1°C from +450°C to +850°C Accuracy to DIN/EN 60584-3 Class 1 (cold junction not included), Cold junction typically < +/- 2 °C.
Resolution	0.0001 (for computational reasons, the 0.01 place is of interest if filtering is set to maximum)
Maximum input voltage	+/- 200 µV

17 General Information

A

A/D
: **A**nalog/**D**igital

AC
: **A**lternating **C**urrent

AM
: **A**mplitude **M**odulation

C

CAN
: **C**ontroller **A**rea **N**etwork

CE
: **C**ommunautés **E**uropéennes
or
Windows CE

COM
: **COM**munication;
The first serial port is identified as COM 1, the second as COM 2, etc.

CTS
: **C**lear **T**o **S**end

D

D/A
: **D**igital/**A**nalog

DC
: **D**irect **C**urrent

DIN
: **D**IN Deutsches **I**nstitut für **N**ormung e.V. [= German Institute for Standardizing]

E

EU
: **E**uropean **U**nion

EC Low Voltage Directive
: To be considered when using electric devices of a rated voltage between 50 and 1,000 V AC and between 75 and 1,500 V DC.

Electro-Magnetic Compatibility (EMC)
: Definition according to the EMC regulations:
"EMC is the ability of a device to function in a satisfactory way in an electro-magnetic environment without causing electromagnetic disturbances itself, which would be unbearable for other devices in this environment."

EMC

Electro-**M**agnetic **C**ompatibility

Definition according to the EMC regulations: "EMC is the ability of a device to function in a satisfactory way in an electro-magnetic environment without causing electromagnetic disturbances itself, which would be unbearable for other devices in this environment."

EN

European Standard

ESD

Electro**s**tatic **D**ischarge

F

Firmware

Startup routines and low-level software are stored in the firmware. Firmware falls between software and hardware in terms of ease of modification.

G

Hazard analysis

Excerpt from the Machinery Directive:

The manufacturer is under an obligation to assess the hazards in order to identify all of those which apply to his machine; he must then design and construct it taking account of his assessment.

I

IEC

International **E**lectrotechnical **C**ommision

IP

International **P**rotection

or

Internet **P**rotocol

J

Jetter system bus

The Jetter system bus is a system-bus system of a cable length of 200 m max., and of fast data transmission rates of 1 Mbit/s. In addition to this, the Jetter system bus is highly immune to interferences. Therefore, the Jetter system bus is suited to realise field bus applications in a limited space.

JetWeb

Control technology comprising control systems, motion systems, user interfaces, visualization devices, remote I/Os and industrial PCs. Programming by means of multitasking and a modern sequence-oriented language. Communication by means of Ethernet TCP/IP and making use of the Web technologies.

L

LED

Light-**E**mitting **D**iode

N

NN

Above sea level

R

RS-232

An accepted industry standard for serial data transmission.

RS: **R**ecommended **S**tandard

For transmission distances of less than 15 m. No differential evaluation. Transmitting and receiving on different lines.

RS-422

An accepted industry standard for serial data transmission.

RS: **R**ecommended **S**tandard

For transmission distances over 15 m. Two differential evaluations each. Transmitting and receiving on different lines.

RS-485

An accepted industry standard for serial data transmission.

RS: **R**ecommended **S**tandard

For transmission distances over 15 m. Two lines with differential evaluation. Transmitting and sending on the same line.

RTS

Request **T**o **S**end

RXD

Receive (**RX**) **D**ata

A line used to carry received serial data from one device to another.

S

SELV

Safe Extra Low Voltage:

Voltage, which, under all operating conditions will not exceed a peak or DC voltage of 42.4 V. This voltage is either measured between two conductors or between one conductor and earth.

The circuit, in which this voltage occurs, must be separated from the mains power supply by a safety isolating transformer or some equivalent.

SUB-D

Type name of a plug-in connector

T

th

Hold time of a burst ('time hold')

tn

Total time of burst ('time normal')

tr

Rise time of burst

TXD

Transmit (**TX**) **D**ata
A line used to carry transmitted serial data from one device to another.

V

Vcc

Supply voltage; generally DC 5 V

18 Glossary – Peripheral Modules

D

Diagnostic bit

A diagnostic bit describes a status. A status can be, for example, missing supply of the actuators or reaching a limit.

Diagnostic bits can be read via status register.

E

ENC

Encoder: "Coding device"

F

Error bit

An error bit marks a critical error requiring intervention by the user. A critical error might be cable break or short circuit.

Error bits can be read via status register.

J

JX3 backplane module

The JX3 modules are linked with each other by means of the backplane module (via the JX3 system bus connector).

The JX3 backplane module is snapped onto the DIN rail.

JX3 module

It consists of a JX3 module enclosure and a JX3 backplane module.

JX3 module enclosure

Contains the specific electronic devices for the respective JX3 module.

JX3 system bus

The JX3 modules are interconnected via the JX3 system bus.

M

Module Register(s)

Every module has got a diagnostics, administration and configuration to be carried out via module register.

The entire register number results from the number of the module register, and of a register prefix. The register prefix is determined by the position of the module in the system.

P

PID

Proportional-Integral-Differential (Controller)

R

Register(s)

Registers can be accessed directly in the application program of the controller, in a setup pane of JetSym, or via the user interface directly. A register is marked by a number consisting of a register prefix and a module register number.

Register prefix

The register prefix is part of the register number. It is determined by the position of a module in the system. The register prefix in connection with the module register number results in the register number.

RTD

Resistive **T**emperature **D**evice, see also

Resistance **T**emperatur **D**evice

Temperature sensor with temperature-dependent resistance

S

Tap Line

Open end of a line connected to the system bus.

U

Universal I/O

Combined digital I/Os are called universal I/Os. Sensors and actuators can be connected to a universal I/O.

W

Thermistor

A thermistor is a thermometer, at which the temperature is measured by means of the temperature dependence of the electric resistance of a substance. Frequently, thermistors are also called resistive sensors. Pt100 and Pt1000, for example, are thermistors.

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